

A First Response Crew Mask for Ammonia, Hydrazine and Combustion Products, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

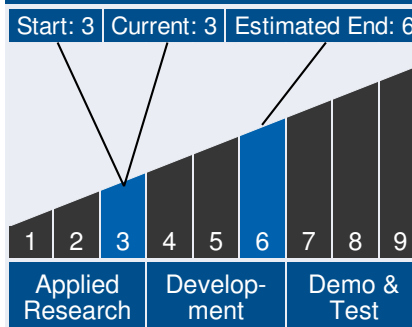
The increasing frequency of International Space Station (ISS) egress operations contaminates the spacecraft environment with propellant residues (such as anhydrous hydrazine) and their decomposition by-products, as well as coolants such as ammonia and Freon. NH₃ and N₂H₄ have a 24 hour Spacecraft Maximum Allowable Concentration (SMAC) of 7 ppm and 0.3 ppm, respectively. TDA Research Inc. is developing a new adsorbent that can remove these contaminants to sub ppmv concentrations with high activity and capacity. The sorbent can be integrated as a thin layer into an existing cartridge used in the ISS first response crew mask; the new media will greatly extend the capability to protect against the NH₃ and hydrazine for extended duration under high contaminant challenges, without undermining the ability of the cartridge to filter out other combustion by-products. In Phase I, we successfully completed all proof-of-concept demonstrations at the bench-scale elevating the TRL to 3. The new adsorbent can provide over 1,400 minutes of protection when challenged with 50 ppmv NH₃ and over 450 hrs with 1 ppmv anhydrous N₂H₄, even at a bed aspect ratio as low as 0.1 and at gas-solid contact times as low as 0.11 sec. The NH₃ and N₂H₄ capacity of the sorbent exceeds 1.8% wt. and 1.4% wt., respectively, with bed outlet concentrations maintained at less than 40 ppbv. In Phase II, we will continue to optimize the sorbent formulations and scale-up the production. We will design and fabricate full-scale experimental prototype cartridges at TDA to support demonstrations in an environmental chamber using a breathing apparatus. Based on the results, we will design and fabricate high fidelity cartridges based on the flight qualified ISS Fire Recovery Respirator Cartridge and complete high fidelity demonstrations in an environmental chamber to fully demonstrate its capability (non-human testing at TRL 6). These will be provided to NASA for additional testing and demonstrations.



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The main product of our research of our research to NASA is a highly capable cartridge to be used in a first response crew mask to protect the astronaut against NH₃ and hydrazine, as well as other combustion by-products. The new cartridge will extend the capabilities of the current cartridge used at the ISS and provide further protection to the crew person against an ammonia and/or hydrazine challenge.

To the commercial space industry:

Potential Non-NASA Commercial Applications: There is a potential commercial opportunity for our technology in commercial safety devices and personal protection systems. We estimated a total market in the U.S. and Europe could exceed 250,000 units per year, assuming an average shelf life of two years for the respirator. The new adsorbent may also find applications in preventing "ammonia slip" from Selective Catalytic Reduction based NO_x Emission Control Units used in power plants.

Management Team (*cont.*)

Project Manager:

- Jeffrey Sweterlitsch

Principal Investigator:

- Gokhan Alptekin

Technology Areas

Primary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Environmental Monitoring, Safety, and Emergency Response (TA 6.4)
 - └ Protective Clothing and Breathing (TA 6.4.3)
 - └ Advanced Respirator (TA 6.4.3.1)

Secondary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Environmental Monitoring, Safety, and Emergency Response (TA 6.4)
 - └ Fire: Detection, Suppression, and Recovery (TA 6.4.2)

Additional Technology Areas:

Aeronautics (TA 15)

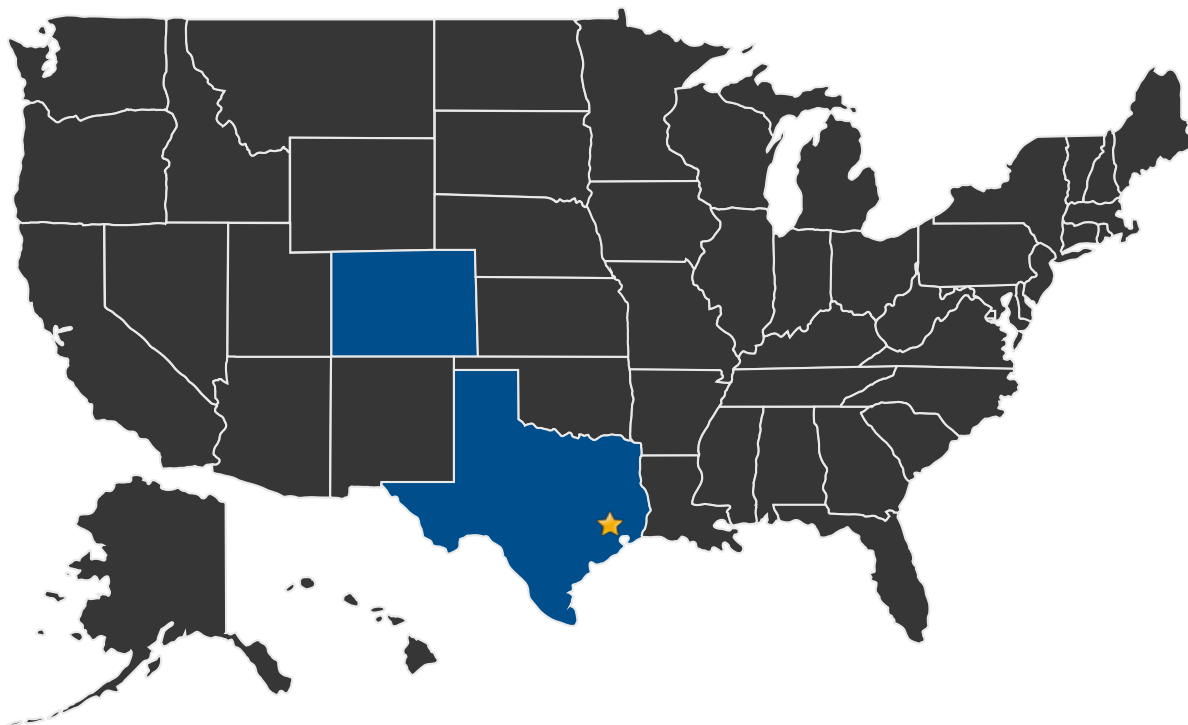
- └ Ultra-Efficient Commercial Vehicles (TA 15.3)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work ★ **Lead Center:**
Johnson Space Center

Other Organizations Performing Work:

- TDA Research, Inc. (Wheat Ridge, CO)

PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23066>)

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IMAGE GALLERY



ISS Fire Recovery Respirator Cartridge

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DETAILS FOR TECHNOLOGY 1

Technology Title

A First Response Crew Mask for Ammonia, Hydrazine and Combustion Products

Potential Applications

The main product of our research of our research to NASA is a highly capable cartridge to be used in a first response crew mask to protect the astronaut against NH₃ and hydrazine, as well as other combustion by-products. The new cartridge will extend the capabilities of the current cartridge used at the ISS and provide further protection to the crew person against an ammonia and/or hydrazine challenge.